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(54) Title of the invention: Moving image coding method and its device, moving image decoding method and its device and moving image recording medium

(57) Abstract:
Purpose: To improve visual image quality of a decoded moving image by generating and sending a flag representing noise quantity for a moving image in the case of coding and adding equivalent noise after decoding to restore the noise lost by the coding.

Constitution: An encoder 18 generates a noise characteristic signal depending on a prescribed function based on a filter characteristic and a quantization coefficient of a pre-filter 19 and sends the signal to a decoder 2 by a recording medium or a transmission line 3 as user data in a bit stream of the MPEG system.

A decoder 31 gives a decoded noise characteristic signal to a post filter 39. The post filter is provided with a white noise generating circuit and adds a white noise signal to a decoded moving image signal based on the noise characteristic signal. The noise characteristic signal is set to add more white noise to the moving image signal as the characteristic of the pre-filter 19 excludes more noise in the moving image signal or the noise elimination factor of the moving image signal is higher because of a higher quantization coefficient.

[Claims]

[Claim 1] In a moving image coding method which codes a moving image signal using a predetermined estimated image signal, performs a predetermined operation to a coded signal, quantizes a signal acquired by the operation concerned and carries out variable length coding of the quantized signal, a moving image coding method coding a noise component lost by the mentioned above coding and transmitting with the mentioned above moving image signal coded.

[Claim 2] The moving image coding method according to claim 1 coding and transmitting a flag which shows noise volume when coding a noise component lost by the mentioned above coding.

[Claim 3] The moving image coding method according to claim 1 computing noise volume by using the characteristic and a quantizing scale of a preprocessing

system and coding the noise volume concerned when coding a noise component lost by the mentioned above coding.

[Claim 4] In the moving image coding device which codes a moving image signal using a predetermined estimated image signal, performs a predetermined operation to a coded signal, quantizes a signal acquired by the operation concerned and carries out variable length coding of the quantized signal, a moving image coding method including a coding means which codes a noise component lost by the mentioned above coding.

[Claim 5] The moving image coding device according to claim 4 characterized by that it codes a flag which shows noise volume when the mentioned above coding means codes a noise component lost by the mentioned above coding.

[Claim 6] The moving image coding device according to claim 4 characterized by that it computes noise volume using the characteristic and a quantizing scale of a preprocessing system and codes the noise volume concerned, when the mentioned above coding means codes a noise component lost by the mentioned above coding.

[Claim 7] In a moving image decoding method which codes a moving image signal using a predetermined estimated image signal, performs a predetermined operation to a coded signal and quantizes a signal

acquired by the operation concerned and with which a quantized signal decodes a moving image signal by which variable length coding was carried out, a moving image decoding method decoding a noise component coded with the mentioned above moving image signal and adding it to a decoded moving image signal.

[Claim 8] The moving image decoding method according to claim 7 characterized by that the mentioned above noise component coded is a flag which shows noise volume.

[Claim 9] In a moving image decoding method which codes a moving image signal using a predetermined estimated image signal, performs a predetermined operation to a coded signal and quantizes a signal acquired by the operation concerned and with which a quantized signal decodes a moving image signal by which variable length coding was carried out, a moving image decoding method characterized by making it add to an image which decoded a noise which computes a noise component lost by the mentioned above coding using a quantizing scale used when coding and is equivalent to the quantizing scale concerned.

[Claim 10] In a moving image decoding device which codes a moving image signal using a predetermined estimated image signal, performs a predetermined operation to a coded signal and quantizes a signal

acquired by the operation concerned and with which a quantized signal decodes a moving image signal by which variable length coding was carried out, a moving image decoding device provided with a noise adding means to decode a noise component coded with the mentioned above moving image signal and to add it to a decoded moving image signal.

[Claim 11] The moving image decoding device according to claim 10 characterized by that the mentioned above noise component coded is a flag which shows noise volume.

[Claim 12] A moving image decoding device which codes a moving image signal using a predetermined estimated image signal, performs a predetermined operation to a coded signal and quantizes a signal acquired by the operation concerned and with which a quantized signal decodes a moving image signal by which variable length coding was carried out, including a noise volume determination means to compute a noise component lost by the mentioned above coding using a quantizing scale used when coding, a noise adding means to add to an image which decoded a noise equivalent to the quantizing scale concerned.

[Claim 13] In a moving image recording medium with which moving image coded with a moving image coding method which quantizes a signal acquired by the operation concerned and carries out variable length

coding of the quantized signal is recorded, a moving image recording medium characterized by that a noise component lost by the mentioned above coding is coded and is recorded with the mentioned above moving image signal coded, coding a moving image signal using a predetermined estimated image signal and a predetermined operation is performed to a coded signal.

[Claim 14] The moving image recording medium according to claim 13 characterized by that a flag which shows noise volume is coded and recorded, when coding a noise component lost by the mentioned above coding.

[Claim 15] The moving image recording medium according to claim 13 characterized by that it computes noise volume by using the characteristic and a quantizing scale of a preprocessing system and the noise volume concerned is coded and recorded, when coding a noise component lost by the mentioned above coding.

[Detailed description of the invention]

[0001] [Table of contents]

This invention is explained in the following order.

Art of the field of the former invention (drawing 17 - drawing 27)

Object of the invention (drawing 20)

The means for solving a technical problem (drawing 1 - drawing 16)

Operation (drawing 1 - drawing 16)

(1) Example, the 1st example (drawing 1 - drawing 12)

(2) The 2nd example (drawing 13 - drawing 16)

Effect of the invention

[0002] [Industrial application]

This invention about a moving image coding method and a device, a moving image decoding method and a device and a moving image recording medium, for example, recording, playing and displaying a moving image signal on recording media, such as an optical disc and magnetic tape, a moving image signal is transmitted to a receiver from the transmitting side by a transmission line like a moving image conference system, a moving image telephone system and the device for broadcast, when receiving and displaying this in a receiver, it uses and it is suitable.

[0003] [Description of the prior art]

For example, like the moving image conference system and the moving image telephone system, in the system which transmits a moving image signal to a remote place, in order to use a transmission line efficiently, performing compression coding of the picture signal using the line correlation and inter frame correlation of a moving image signal. A moving image signal is coded and transmitted to drawing 20 and the

composition of the moving image coding / decoding device which decodes this is shown. The coding device 1 codes the inputted moving image signal VD and transmits it to the recording medium 3 as a transmission line. And the decoding device 2 reproduces the signal recorded on the recording medium 3 and decodes and outputs this.

[0004] In the coding device 1, it is inputted into the preprocessing circuit 11 and separates into a luminance signal and a chrominance signal (in this case, color difference signal) here and analog to digital conversion of the inputted moving image signal VD is carried out with the analog to digital (A/D) converters 12, 13, respectively. Analog to digital conversion is carried out by A/D converters 12, 13 and after filtering is inputted and carried out to the pre-filter 19, a digital signal and a moving image signal are supplied to the frame memory 14 and are stored. The frame memory 14 stores a luminance signal to the luminance signal frame memory 15 and makes the color difference signal frame memory 16 store a color difference signal, respectively.

[0005] The pre-filter 19 raises coding efficiency and performs processing which improves image quality. This is a filter of noise rejection and is a filter for restricting a zone. The composition of a 2D low pass filter is shown on drawing 26 as an example of the pre-filter 19.

The filter factor of this 2D low pass filter is shown on drawing 27 (A) and the 3x3 picture element block used as an input is shown on drawing 27 (B). The 3x3 picture element block of the circumference is extracted to the pixel e used as a certain object. On the other hand, a following formula [Equation 1]

$$1/16 \times a + 1/8 \times b + 1/16 \times c + 1/8 \times d + 1/4 \times e$$

$$+ 1/8 \times f + 1/16 \times g + 1/8 \times h + 1/16 \times i \quad \cdots\cdots (1)$$

the output of an output value of the filter to the pixel e. The output value after filtering is outputted from output OUT1 in practice and the original picture matter value by which filtering is not carried out from output OUT2 is outputted after predetermined delay. With this filter, it is not based on an input picture signal and is not based on the state of coding device, but always uniform filtering is performed.

[0006] The format conversion circuit 17 changes into the entry format of the coding device (encoder) 18 the picture signal stored by the frame memory 14. From the format conversion circuit 17, the data changed into the predetermined format is supplied to the encoder 18 and is encoded here (coding). Although this coding algorithm is arbitrary, details are later mentioned with reference to drawing 22 about one of them. The signal encoded by the encoder 18 is outputted to a transmission line as a bit stream, for example, is recorded on the recording medium 3.

[0007] The data reproduced from the recording medium 3 is supplied to the decoder 31 of the decoding device 2 and is decoded. Although the decoding (decoding) algorithm of the decoder 31 may be arbitrary, it will not become, if there is no coding algorithm and a pair. Details are below mentioned with reference to drawing 25 about one of them. The data decoded by the decoder 31 is inputted into the format conversion circuit 32 and is changed into an output format.

[0008] And the luminance signal of a frame format is supplied to the luminance signal frame memory 34 of the frame memory 33 and is stored and a color difference signal is supplied to the color difference signal frame memory 35 and is stored. The luminance signal and color difference signal which were read from the luminance signal frame memory 34 and the color difference signal frame memory 35, after filtering is supplied and carried out to the post filter 39, D / A conversion is carried out by the digital to analog (D/A) converters 36, 37, respectively and the post-processing circuit 38 is supplied and it is compounded. And for example, it does not illustrate as an output moving image signal, it is outputted and displayed on the display of CRT and the like.

[0009] The post filter 39 performs filtering for improving image quality. It is used in order to ease degradation produced by coding a picture.

For example, it is a filter for removing the noise produced block distortion and near steep edge and a quantization noise. Although there are various kinds of post filters, the same 2D low pass filter can be used as having been used for the pre-filter 19 as shown, for example in drawing 26.

[0010] Next, high efficiency coding of moving image is explained. Conventionally, since there is very much amount of information, in order to carry out prolonged record reproduction of this, the recording medium whose data transmission rate is very high is required and moving image data, such as a moving image signal. Thus, what has large-sized magnetic tape and optical disc was needed. The problem that the existing transmission line is used as it is and it cannot communicate since there is too much data volume even when using moving image data for the case where it communicates by a transmission line or broadcast.

[0011] So, when it is going to record a moving image signal on a smaller recording medium for a long time and when using for communication or broadcast, performing high efficiency coding of the moving image signal and it is recorded and a means to decode the read signal well is indispensable. The low bit rate coding method using correlation of the moving image signal is proposed in order to meet such a demand and one of them has the MPEG (Moving Picture Experts Group) method.

This is discussed by ISO-IEC/JTC1/SC2/WG11, is proposed as a draft standard and is the hybrid system which combined motion compensation prediction coding and discrete cosine transform (DCT) coding.

[0012] Motion compensation prediction coding is a method using correlation of the time base direction of a picture signal. It is a method which decoding reproduction is already carried out and compresses the amount of information required for coding or intermediary signal by predicting the picture inputted now and transmitting only the prediction error at that time. Using the 2D correlativity in a frame which a picture signal has, DCT coding centralizes signal power on a certain specific frequency component and enables compression of the amount of information by coding only this coefficient that carried out concentrating distribution. For example, a pattern is flat and the autocorrelation nature of a picture signal carries out concentrating distribution of the DCT coefficient to low frequency components in a high portion. Thus, the amount of information becomes compressible by coding only the coefficient which carried out concentrating distribution to low-pass in this case. Although the example in the case of the MPEG2 system is next explained in full details as coding device, a coding mode can be similarly applied not only to the MPEG2 system, but to arbitrary coding modes.

[0013] Next, the MPEG2 system is explained in full details. If line correlation is used, a picture signal is compressible by for example, DCT processing and the like If inter frame correlation is used, it will become possible to compress a picture signal further and to code. For example, as shown on drawing 17 in the time t1, t2, t3, when frame image PC1, PC2, PC3 have occurred, respectively, the difference of the picture signal of the frame images PC1 and PC2 is calculated, PC12 is generated and the difference of the frame images PC2 and PC3 is calculated and PC23 is generated. Usually, since the picture of the frame which adjoins in time does not have a so big change, if both differences are calculated, a differential signal will become of a small value. Next, a code amount is compressible if this differential signal is coded.

[0014] However, the original picture cannot be restored if only the differential signal was transmitted. Next, the picture of each frame is made into one picture of three kinds of pictures, I picture, P picture or B picture and compression coding of the picture signal is carried out. That is, for example, as shown on drawing 18, the picture signal of 17 frames to frame F1-F17 is made into a group of picture (GOP) and it may be one unit of processing. And the picture signal of frame F1 of the head is coded as an I picture and the 2nd frame F2 processes the 3rd frame F3 as a B picture as a P picture, respectively.

The frames F4-F17 of the 4th next are processed by turns as B picture or a P picture below.
[0015] The picture signal of I picture transmits the picture signal for the one frame as it is. On the other hand, the picture signal of P picture transmits the difference from the picture signal of I picture or P picture preceded in time than it, as fundamentally shown on drawing 18 (A). Also, as fundamentally shown on drawing 18 (B), the picture signal of B picture asks for the difference from the average value of both the frame preceded in time or the frame which carries out backward and codes the difference.
[0016] Drawing 19 is shown on the principle of the method of doing in this way and coding a moving image signal. Since the first frame F1 is processed as an I picture, it is transmitted to a transmission line as transmission data F1X as it is (formation of a picture inner code). On the other hand, since the 2nd frame F2 is processed as a B picture, the difference of frame F1 preceded in time and the average value of the frame F3 which carries out backward in time calculates and the difference is transmitted as the transmission data F2X.
[0017] But, if the processing as this B picture is explained still more finely, 4 kinds exist. The 1st processing transmits the data of the original frame F2 as the transmission data F2X as it is and turns into the same processing as the case in I picture (intra coding) (SP1). The 2nd processing calculates the difference

from the next frame F3 in time and transmits the difference (SP2) (backward prediction coding). The 3rd processing transmits difference (SP3) with frame F1 preceded in time (forward prediction coding). Also, the 4th processing generates difference (SP4) with the average value of the frame F3 which carries out backward to frame F1 preceded in time and transmits this as the transmission data F2X (both-directions prediction coding).

[0018] The way transmission data decreases most among these 4 methods is adopted. The motion vector x1 (frame F1 and motion vector between F2) (in the case of forward prediction) between the pictures (estimated image) of the frame which serves as an object which calculates difference when transmitting difference data or both x2 (motion vector between the frames F3 and F2) (in the case of backward prediction) or x1, x2 (in the case of both-directions prediction) are transmitted with difference data.

[0019] A differential signal (SP3) with this frame and the motion vector x3 calculate the frame F3 of P picture by using as an estimated image frame F1 preceded in time and this is transmitted as the transmission data F3X (forward prediction coding). Or the data of the original frame F3 is transmitted as the transmission data F3X as it is again (intra coding). (SP1) As for whether it is transmitted by which

method, the direction whose transmission data decreases more is chosen like the case in B picture.

[0020] Next, the composition of the encoder 18 is explained with reference to drawing 22. Image data BD which should be coded is inputted into the motion vector detection circuit (MV-Det) 50 by a macro block unit. The predetermined sequence to which the motion vector detection circuit 50 is set preliminary, the image data of each frame is processed as I picture, P picture or a B picture. Whether the picture of each frame inputted sequentially is processed as which picture of I, P or B. It is set preliminary (for example, as shown on drawing 18, the group of picture constituted by frame F1 - F17 is processed as I, B, P, B, P, ...B, P).

[0021] The image data of the frame (for example, frame F1) processed as an I picture, the image data of the frame (for example, frame F2) which transmits to the front original image part 51a of the frame memory 51, is stored from the motion vector detection circuit 50 and is processed as a B picture, it transmits to the original image part 51b and stores and the image data of the frame (for example, frame F3) processed as a P picture is transmitted to the back original image part 51c and is stored.

[0022] When the picture of the frame which should be further processed as B picture (frame F4) or a P picture (frame F5) is inputted in the following timing, the image data of the first P picture (frame F3) stored by

the back original image part 51c till then, it is transmitted to the front original image part 51a, the image data of the following B picture (frame F4) is stored by the original image part 51b (overwrite) and the image data of the following P picture (frame F5) is stored by the back original image part 51c (overwrite). Such operation is repeated successively.

[0023] The signal of each picture stored by the frame memory 51 is read from there and frame prediction mode processing or field prediction mode processing is performed in the prediction mode switching circuit (Mode-SW) 52. Under control of the prediction decision circuit 54, the operation of the prediction within a picture, forward prediction, backward prediction or both-directions prediction is performed in the operation part 53 further again. It is determined corresponding to a prediction error signal (difference of the image comparison made into the object of processing and the estimated image to this) whether to perform processing among these processings. For this reason, the motion vector detection circuit 50 generates the absolute value sum (the sum of squares may be sufficient) of the prediction error signal used for this judgment.

[0024] Here it is explained the frame prediction mode in the prediction mode switching circuit 52 and field prediction mode. When frame prediction mode is set up, the prediction mode switching circuit 52 outputs 4

luminosity block Y[1] - Y[4] supplied from the motion vector detection circuit 50 to the latter operation part 53 as it is. Namely, the state where the data of the line of an odd number field and the data of the line of an even number field were mixed in each luminosity block as shown on drawing 23 (A) in this case and intermediary. In this frame prediction mode, prediction is performed by making 4 luminosity blocks (macro block) into a unit and 1 motion vector corresponds to 4 luminosity blocks.

[0025] On the other hand, the prediction mode switching circuit 52, as shown on drawing 23 (B), the signal inputted from the motion vector detection circuit 50 in field prediction mode with the composition shown on drawing 23 (A), accepting luminosity block Y [1], Y [2], for example by dots of the line of an odd number field and they are made to constitute among 4 luminosity blocks, the data of the line of an even number field is made to constitute other 2 luminosity block Y [3], Y [4] and they are outputted to the operation part 53. In this case, 1 motion vector corresponds to 2 luminosity block Y [1], Y [2] and other 1 motion vector corresponds to other 2 luminosity block Y [3], Y [4].

[0026] The motion vector detection circuit 50 outputs the absolute value sum of the prediction error in frame prediction mode and the absolute value sum of the prediction error in field prediction mode to the

prediction mode switching circuit 52. The prediction mode switching circuit 52 compares the absolute value sum of the prediction error in frame prediction mode and field prediction mode, performs processing corresponding to the prediction mode in which the value is small and outputs data to the operation part 53. But, this processing is performed actually in the motion vector detection circuit 50. That is, the motion vector detection circuit 50 outputs the signal of the composition corresponding to the determined mode to the prediction mode switching circuit 52 and the prediction mode switching circuit 52 outputs the signal to the latter operation part 53 as it is.

[0027] In the case of frame prediction mode, as shown on drawing 23 (A), a color difference signal is in the state where the data of the line of an odd number field and the data of the line of an even number field are mixed and is supplied to the operation part 53. In the case of field prediction mode, as shown on drawing 23 (B), each color difference block Cb, the upper half (4 lines) of Cr is made into the color difference signal of the odd number field corresponding to luminosity block Y [1], Y [2] and a lower half (4 lines) is made into the color difference signal of the even number field corresponding to luminosity block Y [3], Y [4].

[0028] The motion vector detection circuit 50 generates as follows in the prediction decision circuit 54 the absolute value sum of the prediction error for

determining whether to perform prediction of the prediction within a picture, forward prediction, backward prediction or both-directions prediction. That is, as an absolute value sum of the prediction error of the prediction within a picture, the difference of $\Sigma|Aij|$ of absolute value $|\Sigma Aij|$ of ΣAij of the signal Aij of the macro block of an image comparison and absolute value $|Aij|$ of the signal Aij of a macro block is searched for. It asks for $\Sigma|Aij-Bij|$ of absolute value $|Aij-Bij|$ of difference Aij-Bij of the signal Aij of the macro block of an image comparison and the signal Bij of the macro block of an estimated image as an absolute value sum of the prediction error of forward prediction.

[0029] It asks for the absolute value sum of the prediction error of backward prediction and both-directions prediction as well as (changing the estimated image into a different estimated image from the case in forward prediction) the case in forward prediction. These absolute value sums are supplied to the prediction decision circuit 54. The prediction decision circuit 54 chooses the smallest thing as an absolute value sum of the prediction error of the inta prediction among the absolute value sums of the prediction error of forward prediction, backward prediction and both-directions prediction. Also the absolute value sum of the prediction error of this inta prediction is compared with the absolute value sum of the prediction error of

the prediction within a picture, the smaller one of it is chosen and the mode corresponding to this selected absolute value sum is chosen as prediction mode (P-mode). That is, if the absolute value sum of the prediction error of the prediction within a picture is smaller, the prediction mode within a picture will be set up. The absolute value sum which corresponds among forward prediction, backward prediction or both-directions prediction mode, if the absolute value sum of the prediction error of the inta prediction is smaller, mode is set up.

[0030] Thus, the motion vector detection circuit 50 is the composition corresponding to the mode chosen by the prediction mode switching circuit 52 among a frame or field prediction mode in the signal of the macro block of an image comparison, while supplying the operation part 53 by the prediction mode switching circuit 52, the motion vector between the estimated image corresponding to the prediction mode (P-mode) in which the prediction decision circuit 54 was selected among 4 prediction modes and an image comparison is detected and it outputs to the variable length coding circuit (VLC) 58 and the motion compensation circuit (M-comp) 64. As mentioned above, that from which the corresponding absolute value sum of a prediction error serves as the minimum as this motion vector is chosen.

[0031] When the motion vector detection circuit 50 has read the image data of I picture from the front original image part 51a, the prediction decision circuit 54 sets up frame (picture) inner prediction mode (mode in which a motion compensation is not performed), as prediction mode and changes the switch 53d of the operation part 53 to the point of contact a side. Thus, the image data of I picture is inputted into the DCT mode switching circuit (DCT CTL) 55. As shown on drawing 24 (A) or (B), this DCT mode switching circuit 55, the data of 4 luminosity blocks is changed into the state of either the state (frame DCT mode) where the line of an odd number field and the line of an even number field are mixed or the state (field DCT mode) where it dissociated and is outputted to DCT circuit 56.

[0032] That is, the DCT mode switching circuit 55 compares the coding efficiency at the time of being mixed and carrying out DCT processing of the data of an odd number field and an even number field with the coding efficiency at the time of carrying out DCT processing in the state where it dissociated and chooses the mode with good coding efficiency. For example, the inputted signal is considered as the composition in which the line of an odd number field and an even number field is mixed as shown on drawing 24 (A), the difference of the signal of the line of an odd number field and the signal of the line of an even number field

which adjoins up and down is calculated and it asks for the sum (or sum of squares) of the absolute value further.

[0033] The difference of the signal of the lines of the odd number field which considers the inputted signal as the composition which the line of an odd number field and an even number field separated as shown on drawing 24 (B) and adjoins up and down, the difference of the signal of the lines of an even number field is calculated and it asks for the sum (or sum of squares) of each absolute value. Also both (absolute value sum) are compared and the DCT mode corresponding to a small value is set up. That is, if former one is small, frame DCT mode will be set up and if latter one is small, field DCT mode will be set up. And the data of the composition corresponding to the selected DCT mode is outputted to DCT circuit 56 and the DCT flag (DCT-FLG) which shows the selected DCT mode is outputted to the variable length coding circuit 58 and the motion compensation circuit 64.

[0034] The prediction mode (drawing 23) in the prediction mode switching circuit 52 is compared with the DCT mode (drawing 24) in this DCT mode switching circuit 55 and the data structure in each both modes of a luminosity block is substantially the same so that clearly.

When frame prediction mode (mode in which an odd line and an even line are mixed) is chosen in the prediction mode switching circuit 52, a possibility that frame DCT mode (mode in which an odd line and an even line are mixed) will be chosen even in the DCT mode switching circuit 55 is high, when field prediction mode (mode in which the data of an odd number field and an even number field was separated) is chosen in the prediction mode switching circuit 52, a possibility that field DCT mode (mode in which the data of an odd number field and an even number field was separated) will be chosen is high in the DCT mode switching circuit 55 too.

[0035] But, it not necessarily always is not necessarily made such and in the prediction mode switching circuit 52, the mode is determined that the absolute value sum of a prediction error will become small and the mode is determined that coding efficiency will become good in the DCT mode switching circuit 55. It is inputted into DCT circuit 56, DCT processing is carried out and the image data of I picture outputted from the DCT mode switching circuit 55 is changed into a DCT coefficient. This DCT coefficient is inputted into the quantization circuit (Q) 57 and after being quantized with the quantizing scale (QS) corresponding to the data accumulation amount (quantized control signal (B-full)) of the transmission buffer (Buffer) 59, it is inputted into the variable length coding circuit 58.

[0036] Corresponding to the quantizing scale (QS) supplied from the quantization circuit 57, the image data (in this case, data of I picture) supplied from the quantization circuit 57 is changed into variable length codes, such as Huffman coding, for example and the variable length coding circuit 58 outputs it to the transmission buffer 59. In the variable length coding circuit 58, from the quantization circuit 57 again A quantizing scale (QS), from the prediction decision circuit 54, prediction mode (mode which shows any should be set up between the prediction within a picture, forward prediction, backward prediction or both-directions prediction (P-mode)), the motion vector detection circuit 50, a motion vector (MV) and the prediction mode switching circuit 52, a prediction flag (the flag (P-FLG) which shows any should be set up between frame prediction mode or field prediction mode.) And the DCT flag which the DCT mode switching circuit 55 outputs (the flag (DCT-FLG) which shows any should be set up between frame DCT mode or field DCT mode is inputted and variable length coding also of these is carried out).

[0037] The transmission buffer 59 stores the inputted data temporarily and outputs the data corresponding to an accumulated dose to the quantization circuit 57. The transmission buffer 59 will reduce the data volume of quantization data by enlarging the quantizing scale (QS) of the quantization circuit 57 with a quantized

control signal (B-full), if the data residue increases to permission upper limit. Contrary to this, if a data residue decreases to a permission lower limit, the transmission buffer 59 will increase the data volume of quantization data by making small the quantizing scale (QS) of the quantization circuit 57 with a quantized control signal (B-full). Thus, overflow or underflow of the transmission buffer 59 is prevented. And the data stored in the transmission buffer 59 is read to predetermined timing and is outputted to a transmission line, for example, is recorded on the recording medium 3.

[0038] The data of I picture outputted from the quantization circuit 57 on the other hand is inputted into the inverse quantizing circuit (IQ) 60 and inverse quantization is carried out corresponding to the quantizing scale (QS) supplied from the quantization circuit 57. After the output of the inverse quantizing circuit 60 is inputted into the reverse DCT (IDCT) circuit 61 and reverse DCT processing is carried out, rearrangement of a block is performed by the block rearrangement circuit (Block Change) 65 to each DCT mode (frame/field). By the computing unit 62, the output of the block rearrangement circuit 65 is supplied to the forward prediction picture part (F-P) 63a of the frame memory 63 and is stored.

[0039] The motion vector detection circuit 50 the image data of each frame inputted sequentially, for example, when processing of I B, P, B, P, B… as a picture, respectively, after processing the image data of the frame inputted first as an I picture, before processing the picture of the frame inputted into the next as a B picture, the image data of the frame further inputted into the next is processed as a P picture. It is because B picture cannot be decoded unless P picture as a backward prediction image is prepared previously, in order to be accompanied by backward prediction.

[0040] Next, the motion vector detection circuit 50 is processing of I picture, next starts processing of the image data of P picture stored by the back original image part 51c. And the absolute value sum of the inter-frame difference (prediction error) in a macro block unit is supplied to the prediction mode switching circuit 52 and the prediction decision circuit 54 from the motion vector detection circuit 50 like the case where it is mentioned above. The prediction mode switching circuit 52 and the prediction decision circuit 54 set up the prediction mode of a frame / field prediction mode or the prediction within a picture, forward prediction, backward prediction or both-directions prediction corresponding to the absolute value sum of the prediction error of the macro block of this P picture.

[0041] When the prediction mode in a frame is set up, the operation part 53 is changed to the point of contact a side, as the switch 53d was mentioned above. Thus, this data is transmitted to a transmission line like the data of I picture by the DCT mode switching circuit 55, DCT circuit 56, the quantization circuit 57, the variable length coding circuit 58 and the transmission buffer 59. By the inverse quantizing circuit 60, the inverse DCT circuit 61, the block rearrangement circuit 65 and the computing unit 62, this data is supplied to the backward prediction picture part (B-P) 63b of the frame memory 63 and is stored.

[0042] The switch 53d is changed to the point of contact b at the time of forward prediction mode and. The picture (in this case, picture of I picture) data stored by the forward prediction picture part 63a of the frame memory 63 is read and a motion compensation is carried out corresponding to the motion vector which the motion vector detection circuit 50 outputs by the motion compensation circuit 64. Namely, when it is ordered the motion compensation circuit 64 in setting out in forward prediction mode from the prediction decision circuit 54, only the part corresponding to the position lost-motion vector corresponding to the position of the macro block to which the motion vector detection circuit 50 is outputting the reading address of the forward

prediction picture part 63a now is shifted, data is read and prediction image data is generated.

[0043] The prediction image data outputted from the motion compensation circuit 64 is supplied to the computing unit 53a. The computing unit 53a subtracts the prediction image data corresponding to this macro block supplied from the motion compensation circuit 64 from the data of the macro block of the image comparison supplied from the prediction mode switching circuit 52 and outputs that difference (prediction error). This difference data is transmitted to a transmission line by the DCT mode switching circuit 55, DCT circuit 56, the quantization circuit 57, the variable length coding circuit 58 and the transmission buffer 59. This difference data is locally decoded by the inverse quantizing circuit 60 and the inverse DCT circuit 61 and is inputted into the computing unit 62 by the block rearrangement circuit 65.

[0044] The same data as the prediction image data supplied to the computing unit 53a again is supplied to this computing unit 62. The computing unit 62 adds the prediction image data which the motion compensation circuit 64 outputs to the difference data which the inverse DCT circuit 61 outputs. Thus, the image data of the original P (it decoded) picture is obtained. The image data of this P picture is supplied to the backward prediction picture part 63b of the frame memory 63 and is stored.

[0045] The motion vector detection circuit 50 performs processing of B picture next, after the data of I picture and P picture is stored by the forward prediction picture part 63a and the backward prediction picture part 63b in this way, respectively. The prediction mode switching circuit 52 and the prediction decision circuit 54, corresponding to the size of the absolute value sum of the inter-frame difference in a macro block unit, a frame/field mode is set up and prediction mode is set to either prediction mode in a frame, forward prediction mode, backward prediction mode or both-directions prediction mode. As mentioned above, the switch 53d is changed to the points of contact a, b at the time of the prediction mode in a frame or forward prediction mode. The processing same at this time as the case in P picture is performed and data is transmitted.

[0046] On the other hand, when backward prediction mode or both-directions prediction mode is set up, the switch 53d is changed to the points of contact c, d, respectively. At the time of the backward prediction mode in which the switch 53d is changed to the point of contact c, the picture (in this case, picture of P picture) data stored by the backward prediction picture part 63b is read and a motion compensation is carried out by the motion compensation circuit 64 corresponding to the motion vector which the motion vector detection circuit 50 outputs.

Namely, when it is ordered the motion compensation circuit 64 in setting out in backward prediction mode from the prediction decision circuit 54, only the part corresponding to the position lost-motion vector corresponding to the position of the macro block to which the motion vector detection circuit 50 is outputting the reading address of the backward prediction picture part 63b now is shifted, data is read and prediction image data is generated.

[0047] The prediction image data outputted from the motion compensation circuit 64 is supplied to the computing unit 53b. The computing unit 53b subtracts the prediction image data supplied from the motion compensation circuit 64 from the data of the macro block of the image comparison supplied from the prediction mode switching circuit 52 and outputs the difference. This difference data is transmitted to a transmission line by the DCT mode switching circuit 55, DCT circuit 56, the quantization circuit 57, the variable length coding circuit 58 and the transmission buffer 59.

[0048] The picture (in this case, picture of I picture) data stored by the forward prediction picture part 63a at the time of the both-directions prediction mode in which the switch 53d is changed to the point of contact d, the picture (in this case, picture of P picture) data stored by the backward prediction picture part 63b is read and a motion compensation is carried out by the

motion compensation circuit 64 corresponding to the motion vector which the motion vector detection circuit 50 outputs. Namely, when it is ordered the motion compensation circuit 64 in setting out in both-directions prediction mode from the prediction decision circuit 54, the reading address of the forward prediction picture part 63a and the backward prediction picture part 63b, the motion vector detection circuit 50 shifts only the part corresponding to the position lost-motion vector (the motion vector in this case is set to 2, the object for forward prediction pictures and the object for backward prediction pictures) corresponding to the position of the macro block outputted now, reads data and generates prediction image data.

[0049] The prediction image data outputted from the motion compensation circuit 64 is supplied to the computing unit 53c. The computing unit 53c subtracts the average value of the prediction image data supplied from the motion compensation circuit 64 from the data of the macro block of the image comparison supplied from the motion vector detection circuit 50 and outputs the difference. This difference data is transmitted to a transmission line by the DCT mode switching circuit 55, DCT circuit 56, the quantization circuit 57, the variable length coding circuit 58 and the transmission buffer 59. Since the picture of B picture is not used as the estimated image of other pictures, it is not stored by the frame memory 63.

[0050] In the frame memory 63, bank switching is performed if needed and to a predetermined image comparison, the forward prediction picture part 63a and the backward prediction picture part 63b can change what is stored on one side or another side as a forward prediction picture or a backward prediction picture and can output it. In the above explanation, although explained focusing on the luminosity block, about a color difference block, similarly, it is processed as a unit and the macro block shown on drawing 23 and drawing 24 is transmitted. What set to one half the motion vector of the luminosity block with which the motion vector in the case of processing a color difference block corresponds to the perpendicular direction and the horizontal direction, respectively is used.

[0051] Next, the composition of the decoder 31 of drawing 20 is shown on drawing 25. After being received in the receiving circuit which is not represented or being reproduced with playback equipment and storing temporarily the coded image data which was transmitted by the transmission line (recording medium 3) at the receive buffer (Buffer) 81, it is supplied to the variable length decoding circuit (IVLC) 82 of the decoder circuit 90. The variable length decoding circuit 82 carries out variable length decoding of the data supplied from the receive buffer 81 and supplies a motion vector (MV), prediction

mode (P-mode) and a prediction flag (P-FLG) to the motion compensation circuit (M-comp) 87. Outputting a DCT flag (DCT-FLG) to the reverse block rearrangement circuit (Block Change) 88 and a quantizing scale (QS) is outputted to the inverse quantizing circuit (IQ) 83, respectively and the decoded image data is outputted to the inverse quantizing circuit 83.

[0052] The quantizing scale (QS) with which the image data supplied from the variable length decoding circuit 82 was similarly supplied to the inverse quantizing circuit 83 from the variable length decoding circuit 82, thus, inverse quantization is carried out and it outputs to the inverse DCT circuit (IDCT) 84. Reverse DCT processing is carried out in the inverse DCT circuit 84 and the data (DCT coefficient) outputted from the inverse quantizing circuit 83 is supplied to the computing unit 85 by the block rearrangement circuit 88. When the image data supplied from the inverse DCT circuit 84 is data of I picture, the data is outputted from the computing unit 85, for prediction image data generation of the image data (data of P or B picture) behind inputted into the computing unit 85, is supplied to the forward prediction picture part (F-P) 86a of the frame memory 86 and is stored. This data is outputted to the format conversion circuit 32 (drawing 20).

[0053] The image data supplied from the inverse DCT circuit 84, the image data in front of one of them by the data of P picture used as prediction image data, when it is data in forward prediction mode, the image data (data of I picture) before the forward prediction picture part 86a of the frame memory 86 stores is read and the motion compensation corresponding to the motion vector outputted from the variable length decoding circuit 82 in the motion compensation circuit 87 is given. And in the computing unit 85, it is added with the image data (data of difference) supplied from the inverse DCT circuit 84 and is outputted. For prediction image data generation of the image data (data of B picture or P picture) behind inputted into the computing unit 85, this added data, namely, the decoded data of P picture, is supplied to the backward prediction image part (B-P) 86b of the frame memory 86 and it is stored.

[0054] As for the data in the prediction mode within a picture, as well as the data of I picture does not perform processing in particular with the computing unit 85 by the data of P picture, but the backward prediction picture part 86b stores as it is. Since this P picture is a picture which should be displayed on the next of the following B picture, it is not outputted to the format conversion circuit 32 yet at this time (as mentioned above, P picture inputted after B picture is processed ahead of B picture and is transmitted).

[0055] When the image data supplied from the inverse DCT circuit 84 is data of B picture, it corresponds to the prediction mode supplied from the variable length decoding circuit 82, the image data of I picture stored by the forward prediction picture part 86a of the frame memory 86 (in the case of forward prediction mode), the image data of P picture stored by the backward prediction picture part 86b (in the case of backward prediction mode) or the image data (in the case of both-directions prediction mode) of the both is read, the motion compensation corresponding to the motion vector outputted from the variable length decoding circuit 82 in the motion compensation circuit 87 is given and an estimated image is generated. However, an estimated image is not generated when you do not need a motion compensation (in the case of the prediction mode within a picture).
[0056] Thus, the data in which the motion compensation was given is added with the output of the inverse DCT circuit 84 in the computing unit 85 in the motion compensation circuit 87. This added output is outputted to the format conversion circuit 32. But, this added output is data of B picture and since it is not used for estimated image generation of other pictures, it is not stored by the frame memory 86. After the picture of B picture is outputted, the image data of P picture stored by the backward prediction picture part 86b is read and the computing unit 85 is supplied by

the motion compensation circuit 87. However, a motion compensation is not performed at this time.

[0057] Although the circuit corresponding to the prediction mode switching circuit 52 and the DCT mode switching circuit 55 in the encoder 18 of drawing 22 is not represented by this decoder 31, the motion compensation circuit 87 performs processing which returns the processing corresponding to these circuits, namely, the composition from which the signal of the line of an odd number field and an even number field was separated, to the mixed original composition if needed. In the above explanation, although processing of the luminance signal was described, processing of a color difference signal is performed similarly. However, as for a motion vector, a perpendicular direction and the thing horizontally set to one half are used for luminance signals in this case.

[0058] [Problems to be solved by the invention]

By the way, in the coding device 1 of moving image which was mentioned above to drawing 20, the pre-filter 19 is used in order to remove the noise contained in an input picture signal and to raise the coding efficiency in the coding device 1 and in order to reduce the amount of information to the specified quantity. The post filter 39 eases degradation of a decoding picture and it is used in order to improve image quality. Here, the noise contained in a picture is considered. There are various kinds of noises.

For example, granular noises peculiar to a film exist with the noise produced when passing by a transmission line and film source, such as a movie.

[0059] It produces without meaning with the noise intentionally contained in the noise contained in such a picture and the cause and intermediary noise of degradation exist. In the pre-filter 19, these noises are reduced fair. When a picture signal is coded, it will change to the noise of character which the high frequency components of a picture are reduced and noise is reduced by this or is different from the original noise. Thus, when noises are reduced, if reduced too much, it will become a different picture of an impression from an original image and will become degradation of a picture on the contrary. In the case of the noise contained especially intentionally, this poses a problem.

[0060] Thus, according to this moving image coding method, the pre-filter 19 and the coding device 1 reduce noises too much and the problem of degrading a picture on the contrary exists. A quantization noise arises in the coded picture. The cause in which especially this is conspicuous near edge that image quality deterioration is big.

[0061] This invention was made in consideration of the above point, tends to restore the noise lost when coding and decoding moving image and tends to propose the moving image coding method and the

device, the moving image decoding method and device and moving image recording medium which may improve the image quality of the moving image decoded visually.

[0062] [Means for solving the problem]

In this invention in order to solve this technical problem, in a moving image coding method which codes a moving image signal using a predetermined estimated image signal, performs a predetermined operation to a coded signal, quantizes a signal acquired by the operation and carries out variable length coding of the quantized signal, a noise component lost by coding is coded and it transmits with a coded moving image signal.

[0063] In this invention, a moving image signal is coded using a predetermined estimated image signal, a predetermined operation is performed to a coded signal and a coding means (18) which codes a noise component lost by coding was established in moving image coding device (1) which quantizes a signal acquired by the operation and carries out variable length coding of the quantized signal.

[0064] In this invention, a moving image signal is coded using a predetermined estimated image signal, a predetermined operation was performed to a coded signal, a signal acquired by the operation was quantized and in a moving image decoding method which decodes a moving image signal by which

variable length coding was carried out, a quantized signal decodes a noise component coded with a moving image signal and added it to a decoded moving image signal.

[0065] In this invention, a moving image signal is coded using a predetermined estimated image signal, in a moving image decoding method which performs a predetermined operation to a coded signal and quantizes a signal acquired by the operation and with which a quantized signal decodes a moving image signal by which variable length coding was carried out, a noise component lost by coding is computed using a quantizing scale used when coding and it was made to add to an image which decoded a noise equivalent to the quantizing scale.

[0066] In this invention, a moving image signal is coded using a predetermined estimated image signal, in a moving image decoding device (2) which performs a predetermined operation to a coded signal and quantizes a signal acquired by the operation and with which a quantized signal decodes a moving image signal by which variable length coding was carried out, a noise adding means (39) to have decoded a noise component coded with a moving image signal and to add it to a decoded moving image signal was formed.

[0067] In this invention, a moving image signal is coded using a predetermined estimated image signal, in a moving image decoding device (2) which

performs a predetermined operation to a coded signal and quantizes a signal acquired by the operation and with which a quantized signal decodes a moving image signal by which variable length coding was carried out, it carried out for forming a noise volume determination means (39D) to compute a noise component lost by coding using a quantizing scale (QS) used when coding.

[0068] In this invention, a moving image signal is coded using a predetermined estimated image signal, in a moving image recording medium (3) with which moving image coded with a moving image coding method which performs a predetermined operation to a coded signal, quantizes a signal acquired by the operation and carries out variable length coding of the quantized signal is recorded, a noise component lost by coding is coded and it was made to be recorded with a coded moving image signal.

[0069] [Function]

When coding a moving image signal, after having detected the noise volume contained in a picture, coding and transmitting the flag which shows the noise volume and decoding a bit stream in a decoding device, it was made the flag which shows the noise volume, but an intermediary noise is added. It becomes possible to reproduce the noise component lost by coding by this.

By adding with post filter the quantization noise produced by coding and the noise of the level, degradation of a quantization noise and the like can be made not conspicuous.

[0070] [Example]

About a drawing, one example of this invention is explained in full details next.

[0071] (1) The moving image coding device and decoding device by the 1st example of this invention are shown on drawing 1 which gave identical codes to the corresponding point with 1st example drawing 20. In the case of this example, the encoder 18 determines the noise volume added in the post filter 39 with the characteristic of the filter used by the pre-filter 19, corresponding to the conditions at the time of coding and codes the addition noise drawing signal NA which shows it. 2 kinds of noise drawing deciding methods which determine this addition noise drawing signal NA exist. The 1st noise drawing deciding method inputs and sets up the addition noise drawing signal NA compulsorily from the outside and the 2nd noise drawing deciding method determines the addition noise drawing signal NA based on the various flags generated at the time of coding.

[0072] Identical codes are given to a corresponding point with drawing 22 and the composition of the encoder 18 by the 1st noise drawing deciding method is shown on drawing 2.

The addition noise drawing signal NA inputted from the outside is inputted into the variable length coding device 58. With the variable length coding device 58, while performing the same variable length coding as usual, variable length coding of the noise drawing signal NA is carried out. The addition noise drawing signal NA is recorded on the user data in a bit stream. Since the user data in the MPEG system or the MPEG2 system can be set up after a sequence, GOP and a picture header, PST can be similarly set up by a sequence, GOP and a picture unit.
[0073] The syntax of the moving image of the MPEG system is shown on drawing 3. Extended data or user data is recorded on the extension / user data extension-and-user-data(i) which attached the drawing line. Extension / user data extension-and-user-data(i) and extended data extension-data are shown on drawing 4 (A) and drawing 4 (B). When user data start code user-data-start-code is recorded on extension / user data extension-and-user-data(i), it is shown that user data is recorded next. Next, user data is shown on drawing 4 (C). User data is recorded by 8 bits. Generating of «0000 0000 0000 0000 00000001» shows that user data is completed.
[0074] Next, the addition noise drawing signal NA is explained. The addition noise drawing signal NA is a signal of 8 bits, as shown on drawing 6. The addition noise drawing signal NA is recorded on user data

shown on drawing 3 and drawing 4.The characteristics 0 are most little noises and the characteristic 255 is a lot of noises. The processing which adds a noise with this addition noise drawing signal NA is mentioned below.

[0075] The addition noise drawing signal NA can be set up by a sequence, GOP and user data after a picture header. Once the addition noise drawing signal NA is set up, the value will be used until it next resets. That is, the same noise is added until it resets. The addition noise drawing signal NA is first set up by a sequence header. When resetting after that, it may set up by a sequence, GOP and any backward user data of a picture header.

[0076] Next, the composition of the encoder 18 by the 2nd noise drawing deciding method is shown on drawing 7 which gave identical codes to the corresponding point with drawing 2. The addition noise determining circuit 70 determines the noise volume added in the post filter 39 (drawing 1) from the filter property used in the quantizing scale (QS) and the pre-filter 19 (drawing 1) which are inputted into the variable length coding device 58. The addition noise determining circuit 70 outputs the flag and the addition noise drawing signal NA which show the noise volume added in the post filter 39 to the variable length coding device 58.

In the variable length coding device 58, variable length coding of the addition noise drawing signal NA is carried out like the case of the 1st noise drawing deciding method.

[0077] One of them is explained about the deciding method of the addition noise drawing signal NA in this 2nd noise drawing deciding method. Quantization is performed in the encoder 18 and it can code to the signal of small-size width, so that a quantizing scale (QS) is small in that case. Thus, it transmits to the noise contained in an original image, so that a quantizing scale (QS) is small. If a quantizing scale (QS) is large, it will become impossible to transmit a noise and a decoded image will turn into a flat image from which the noise was removed.

[0078] Filtering is performed by the pre-filter 19 in the coding device 1. Although various processings exist in this filtering, noise rejection processing is that example. A low pass filter is also effective in decreasing a noise besides a noise rejection filter. Noise volume reproducible with a decoded image by the degree of noise rejection with such a filter is decided. That is, when hardly removing a noise by the pre-filter 19, it is possible to transmit the noise component contained in an original image, but it becomes impossible to transmit a noise, when most noises are removed by the pre-filter 19.

[0079] Thus, the addition noise drawing signal NA is determined by the degree of the noise rejection in a quantizing scale (QS) and the pre-filter 19. That is, the noise volume added by the post filter 39 increases, so that the degree of the noise rejection of the pre-filter 19 is so large that a quantizing scale (QS) is large. Adding a noise by the post filter 39 has an effect which it not only restores the noise lost on the occasion of coding, but makes not conspicuous degradation of the quantization noise and the like which were produced by coding.

[0080] This is explained using drawing 8. Degradation produced near edge and block distortion are among degradation produced by coding. Drawing 8 (A) is an original image and drawing 8 (B) shows that degradation produced near edge. Drawing 8 (C) added the noise produced by degradation and the noise of the level to this. Stopping being conspicuous by adding a noise understands.

[0081] A quantizing scale (QS) serves as a rule of thumb of the degree of such degradation. A quantizing scale (QS) is considered that there is little degradation when small and a quantizing scale (QS) is considered that degradation becomes remarkable when large. Thus, the noise volume which the noise volume added also from a viewpoint which makes degradation not conspicuous, so that a quantizing scale (QS) is large

increases and is added, so that a quantizing scale (QS) is small decreases.

[0082] How to determine the addition noise drawing signal NA from a quantizing scale (QS) and filter property F1- FN of the pre-filter 19 is shown on drawing 9. Although there is strength of the pre-filter 19 here, many noises are removed as a strong filter and a noise is saved as a weak filter. The example is shown on drawing 10. F1 - FN are filter factors as a frequency characteristic shows to drawing 10. F1 is a filter in which FN is the strongest weakest again.

[0083] The syntax of a macro block header in the case of the MPEG system or the MPEG2 system is shown on drawing 5. As a drawing line shows, a quantization coefficient (quantizer scale code) is set up by a macro block unit. After one frame codes first, average value MEAN-Q of the quantization coefficient in one frame is calculated. Drawing 9 is the method of determining the addition noise drawing signal NA from filter property F1- FN of average value MEAN-Q of a quantization coefficient and the pre-filter 19. Thus, the addition noise drawing signal NA is determined.

[0084] Next, the composition of the decoder 31 (drawing 1) in this 1st example is shown on drawing 11 which gave identical codes to the corresponding point with drawing 25. The 1st and 2nd noise drawing deciding methods are decoded by the decoder circuit 90 shown on drawing 11.

If a bit stream is inputted into the decoder 31, it will be first inputted into the variable length decoding circuit 82 and variable length coding will be solved. The addition noise drawing signal NA currently recorded on user data, user data at this time is decoded and it is outputted to the post filter 39 (drawing 1). Operation of the other decoders 31 is the same as that of the method indicated to the former.

[0085] The post filter 39 is shown on drawing 12. The noise generating circuit 39A generates random white noise. This is realizable in the circuit which generates M sequence. The addition noise drawing signal NA decoded by the decoder 31 is inputted into the addition noise determining circuit 39B. The addition noise determining circuit 39B, the addition noise drawing signal NA, thus, the noise volume added to a picture signal is determined. The inputted picture signal and the generated noise are inputted and added to the adder 39C. The output of the adder 39C is inputted into D/A converters 36, 37 (drawing 1) as an output of the post filter 39.

[0086] When coding a moving image signal according to the above composition, the addition noise drawing signal NA which detects the noise volume contained in a picture and shows the noise volume is coded and transmitted, the addition noise drawing signal NA which shows the noise volume after decoding a bit stream to the decoding side, thus, by having added the

noise, it comes out to reproduce the noise component lost by coding. By adding the quantization noise produced by coding and the noise of the level by a post filter, it is not conspicuous, degradation of a quantization noise and the like can be performed and the image quality of the moving image decoded visually in this way may be improved.

[0087] (2) The moving image coding device and decoding device by the 2nd example of this invention are shown on drawing 13 which gave identical codes to the corresponding point with 2nd example drawing 1. About the coding device 1, it is the same as usual. As the 1st example explained, it depends on a quantizing scale (QS) for the noise volume which should be added. Although a quantizing scale (QS) is set up by a macro block unit, user data and a picture unit can be transmitted only by a sequence, GOP. In this 2nd example, the noise volume added by a macro block unit is determined.

[0088] The decoder 31 in the 2nd example is explained using drawing 14 which gave identical codes to the corresponding point with drawing 11. If a bit stream is inputted into the decoder 31, it will be inputted into the variable length decoding circuit 82 and a variable length code will be solved. The addition noise drawing signal NA and quantizing scale (QS) which are recorded on user data at this time are outputted to the

post filter 39. Operation of the other decoders 31 is the same as that of the method indicated to the former.

[0089] The post filter 39 in the 2nd example is explained using drawing 15 which gave identical codes to the corresponding point with drawing 12. In this example, the addition noise drawing signal NA and a quantizing scale (QS) are inputted into the noise volume determining circuit 39D. The noise volume determining circuit 39D determines the noise volume added in the post filter 39 from the addition noise drawing signal NA and a quantizing scale (QS). A noise volume deciding method is shown on drawing 16. Determined noise volume NA' is outputted to the addition noise determining circuit 39B.

[0090] The addition noise determining circuit 39B determines the noise added to a picture signal like the 1st example. The inputted picture signal and the generated noise are inputted and added to the adder 39C. The output of the adder 39C is inputted into D/A converters 36, 37 (drawing 1) as an output of the post filter 39. Other operations are completely the same as that of the 1st example.

[0091] When coding a moving image signal according to the above composition, the addition noise drawing signal NA which detects the noise volume contained in a picture and shows the noise volume is coded and transmitted, the addition noise drawing signal NA and quantizing scale (QS) in which the noise volume is

shown after decoding a bit stream to the decoding side, thus, by having added the noise, it comes out to reproduce the noise component lost by coding. By adding the quantization noise produced by coding and the noise of the level by a post filter, it is not conspicuous, degradation of a quantization noise and the like can be performed and the image quality of the decoded moving image visually in this way may be improved.

[0092] [Effect of the invention]

As mentioned above, by this invention, when coding a moving image signal, the addition noise drawing signal which detects the noise volume contained in a picture and shows the noise volume is coded and transmitted, the addition noise drawing signal which shows the noise volume after decoding a bit stream to the decoding side and a quantizing scale, thus, the noise was added. Thus, the noise component lost by coding can be reproduced. By adding the quantization noise produced by coding and the noise of the level by a post filter, degradation of a quantization noise and the like can be made not conspicuous and the moving image coding method and the device, the moving image decoding method, device and moving image recording medium which may improve the image quality of the moving image decoded visually in this way can be realized.

[Brief description of the drawings]

[Drawing 1] is a block diagram showing the composition of moving image coding / decoding device of the 1st example by this invention.

[Drawing 2] is a block diagram showing the composition of the encoder of the coding device of drawing 1.

[Drawing 3] is a chart showing the syntax of the moving image of the MPEG system.

[Drawing 4] is a chart showing extension/user data of the syntax of the moving image of the MPEG system.

[Drawing 5] is a chart showing the syntax of the macro block of the moving image of the MPEG system.

[Drawing 6] is a chart showing the contents of the addition noise drawing signal NA.

[Drawing 7] is a block diagram showing the composition of the encoder of the coding device of drawing 1.

[Drawing 8] is a characteristic curve sheet with which the explanation which reproduces a noise component and improves image quality is presented.

[Drawing 9] is a characteristic curve sheet with which explanation of the deciding method of an addition noise drawing signal is presented.

[Drawing 10] is a characteristic curve sheet with which explanation of the frequency characteristic of a filter factor is presented.

[Drawing 11] is a block diagram showing the composition of the decoder of the decoding device of drawing 1.

[Drawing 12] is a block diagram showing the composition of the post filter of the decoding device of drawing 1.

[Drawing 13] is a block diagram showing the composition of moving image coding / decoding device of the 2nd example by this invention.

[Drawing 14] is a block diagram showing the composition of the decoder of the decoding device of drawing 13.

[Drawing 15] is a block diagram showing the composition of the post filter of the decoding device of drawing 13.

[Drawing 16] is a characteristic curve sheet with which explanation of the deciding method of an addition noise drawing signal is presented.

[Drawing 17] is an approximate line drawing with which explanation of the principle of high efficiency coding using frame correlation of a moving image signal is presented.

[Drawing 18] is an approximate line drawing with which explanation of the picture type in the case of compressing a moving image signal is presented.

[Drawing 19] is an approximate line drawing with which explanation of the principle of the moving image signal coding method is presented.

[Drawing 20] is a block diagram showing the composition of the conventional moving image coding / decoding device.

[Drawing 21] is an approximate line drawing showing the structure of image data as explanation of operation of a format conversion circuit.

[Drawing 22] is a block diagram showing the composition of the encoder in moving image coding / decoding device of drawing 20.

[Drawing 23] is an approximate line drawing with which explanation of operation of the prediction mode switching circuit of an encoder is presented.

[Drawing 24] is an approximate line drawing with which explanation of operation of the DCT mode switching circuit of an encoder is presented.

[Drawing 25] is a block diagram showing the composition of the decoder in moving image coding / decoding device of drawing 20.

[Drawing 26] is a connection diagram showing the composition of a 2D low pass filter as the pre-filter/ post filter in moving image coding / decoding device of drawing 20.

[Drawing 27] is an approximate line drawing with which explanation of the coefficient of the 2D low pass filter of drawing 26 is presented.

[Description of numerals]

1... Coding device,
2... A decoding device,
3... Recording medium (transmission line),
11... A preprocessing circuit,
12, 13... Analog to digital (A/D) converter,
14, 33... A frame memory,
15, 34... A luminance signal frame memory,
16, 35... A color difference signal frame memory,
17, 32... A format conversion circuit,
18... An encoder,
19... A pre-filter,
20... Memory storage,
21... A coefficient determining circuit,
22... A coding rate determining circuit,
31... A decoder,
36, 37... Digital to analog (D/A) converter,
38... A post-processing circuit,

50… a motion vector detection circuit (MV-Det),
51… A frame memory,
51a… A front original image part,
51b… An original image part,
51c… A back original image part,
52… A prediction mode switching circuit (Mode-SW),
53… An operation part,
54… A prediction decision circuit,
55… A DCT mode switching circuit (DCT CTL),
56… A DCT circuit,
57… A quantization circuit (Q),
58… A variable length coding circuit (VLC),
59… A transmission buffer (Buffer),
60, 83… An inverse quantizing circuit (IQ),
61, 84… An inverse DCT circuit (IDCT),
62, 85… A computing unit,
63, 86… Frame memory,
63a, 86a… A forward prediction picture (F-P),
63b, 86b… A backward prediction picture (B-P),
64, 87… A motion compensation circuit (M-comp),
65, 88… A DCT-blocks rearrangement circuit,
70… An addition noise determining circuit,
81… A receive buffer (Buffer),
82… A variable length decoding circuit (IVLC)

Drawing 6

付加ノイズ特性信号	ノイズ特性
00000000	特性０
00000001	特性１
00000010	特性２
•	•
•	•
•	•
•	•
11111111	特性２５５

Drawing 8

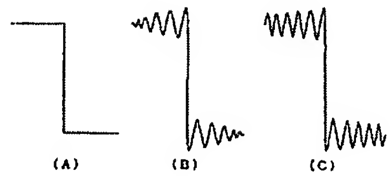
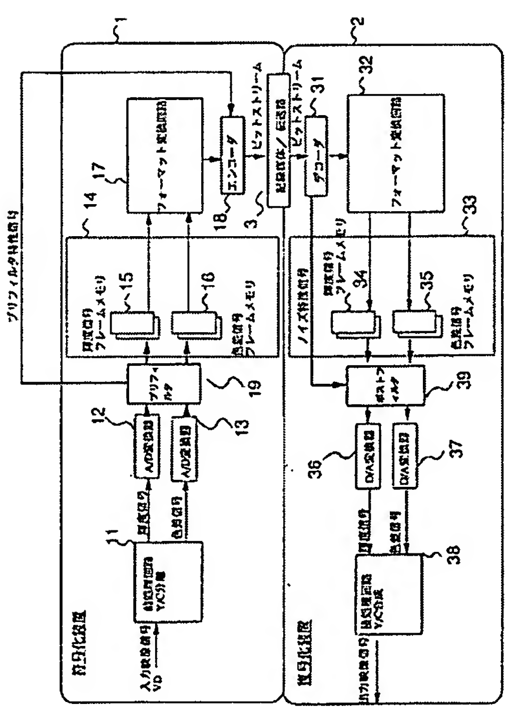
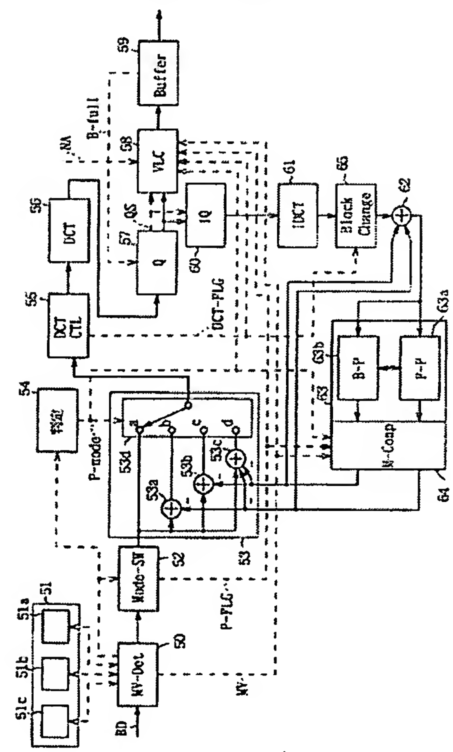


図8 ノイズ付加の原理

Drawing 1



Drawing 2



Drawing 3

```
video-sequence(){
      next-start-code()
      sequence-header()
      if(next-bits() -- extension-start-code) { ... MPEG2
            sequence-extension()
            do {
                  extension-and-user-data(0)..... NA
                  do {
                        if(next-bits() == group-start-code) {
                              group-of-pictures-header()
                              extension-and-user-data(1).......NA
                        }
                        picture-header()
                        extension-and-user-data(2)...... NA
                        picture-data()
                  } while((next-bits() == picture-start-code) ||
                          next-bits() == group-start-code))
                  if(next-bits() != sequence-end-code) {
                        sequence-header()
                        sequence-extension()
                  }
            } while(next-bits != sequence-end-code)
      } else {                          ............ MPEG1
            do {
                  do {
                        group-of-pictures-header()
                        if(next-bits() == user-data-start-code)
                              user-data()
                        do {
                              picture-header()
                              if(next-bits() ==
                                     user-data-start-code)
                                    user-data()
                              picture-data()
                        } while(next-bits() == picture-start-code)
                  } while(next-bits() == group-start-code)
                  if(next-bits() != sequence-end-code)
                        sequence-header()
            } while(next-bits() != sequence-end-code)
      }
      sequence-end-code
}
```

Drawing 9

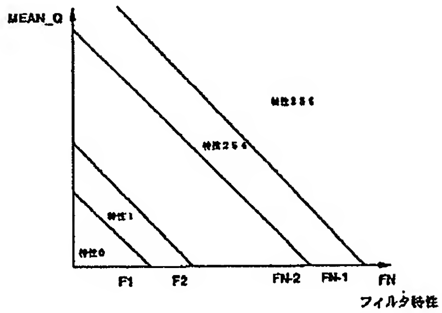
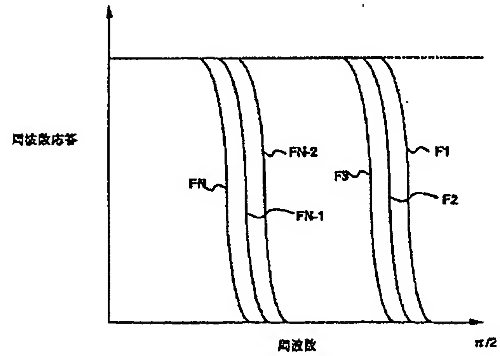


図9　付加ノイズ特性信号の決定方法

Drawing 10



Drawing 5

```
macroblock()
      while(next-bits() == ' 0000 0001 000')
            macroblock-escape                    11      bslbf
      macroblock-address-increment               1-11      vlclbf
      macroblock-modes()
      if(macroblock-quant)
            quantiser-scale-code                 5      uimsbf
      if(macroblock-motion-foward ||
            (macroblock-intra && concealment-motion-vectors))
            motion-vectors(0)
      if(macroblock-motion-backward)
            motion-vectors(1)
      if(macroblock-intra && concealment-motion-vectors)
            marker-bit                           1      bslbf
      if(macroblock-pattern)
            coded-block-pattern()
      for(i = 0; i < block-count; i++) {
            block(i)
      }
}
```

Drawing 4

```
extension-and-user-data(i) {
      while((next-bits() == extension-start-code) ||
                (next-bits() == user-data-start-code)) {
            if(i != 1)
                  if(next-bits() == extension-start-code)
                        extension-data(i)
            if(next-bits() == user-data-start-code)
                  user-data()
      }
}
```

(A)

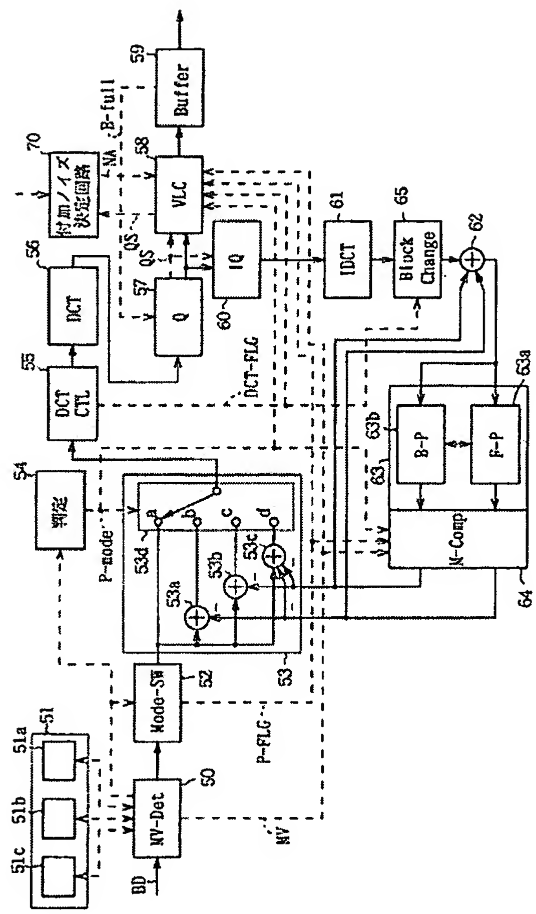
```
extension-data(i) {
      while(next-bits() == extension-start-code) {
            extension-start-code                              32    bslbf
            if(i == 0) { /*sequence-extension*/
                  if(next-bits() == "Sequence Display Extension ID")
                        sequence-display-extension()
                  if(next-bits() == "Sequence Scalable Extension ID")
                        sequence-scalable-extension()
            }

            if(i == 2) {
                  if(next-bits() == "Quant Matrix Extension ID")
                        quant-matrix-extension()
                  if(next-bits() == "Picture Pan Scan Extension ID")
                        picture-display-extension()
                  if(next-bits() ==
                        "Picture Spatial Scalable Extension ID")
                        picture-spatial-scalable-extension()
                  if(next-bits() ==
                        "Picture Temporal Scalable Ext. ID")
                        picture-temporal-extension()
            }
      }
}
```

(B)

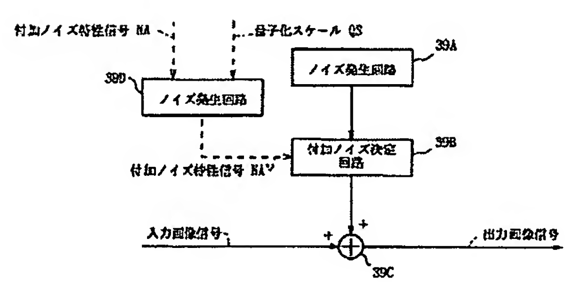
```
user-data() {
      user-data-start-code                           32      bslbf
      while(next-bits() != '0000 0000 0000 0000 0000 0001') {
            user-data                        8

      }
      next-start-code()
}
```

(C)

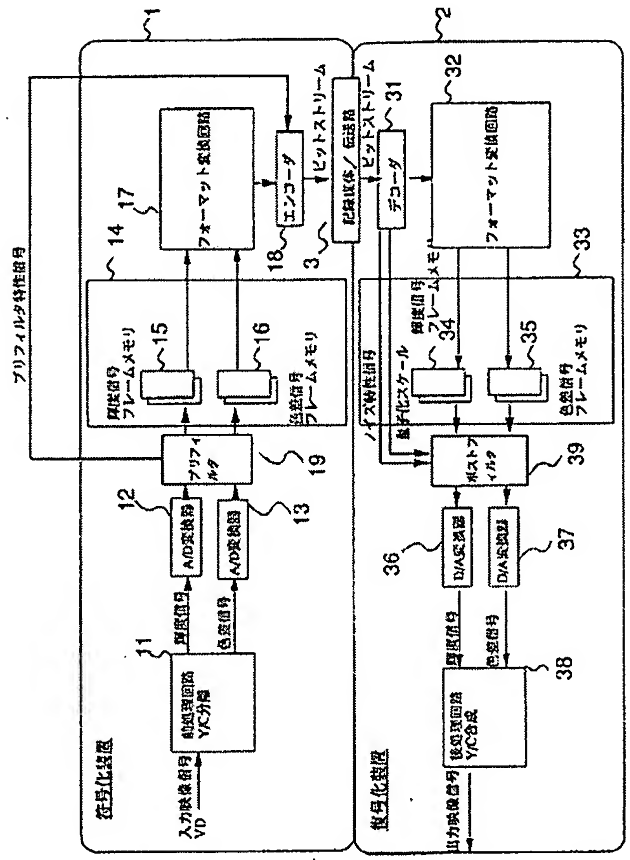
Drawing 7



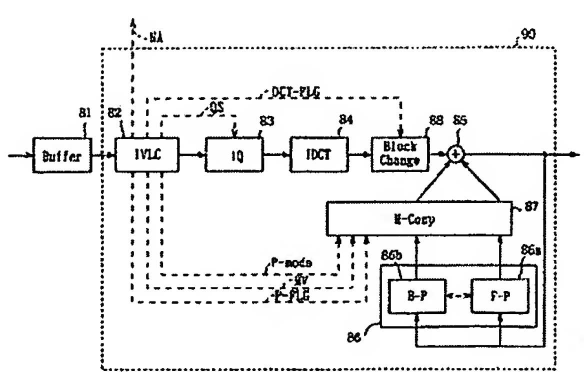
Drawing 15



Drawing 13



Drawing 11



Drawing 27

1/16	1/8	1/16
1/8	1/4	1/8
1/16	1/8	1/16

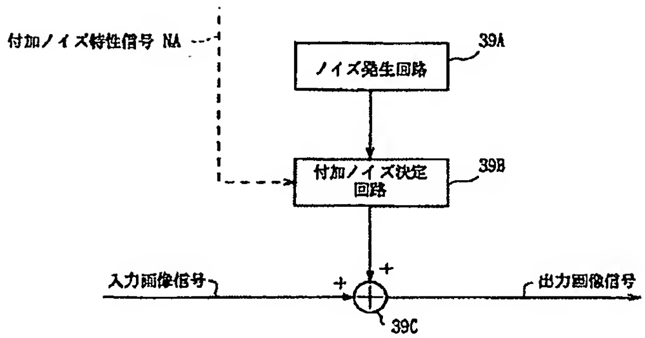
（A） 3×3フィルタ係数

a	b	c
d		f
g	h	i

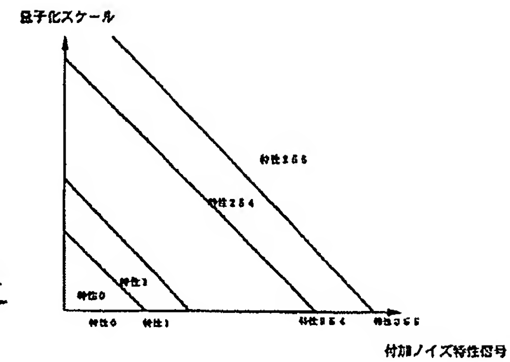
（B） 3×3入力画素ブロック

図27 2次元ローパスフィルタの係数

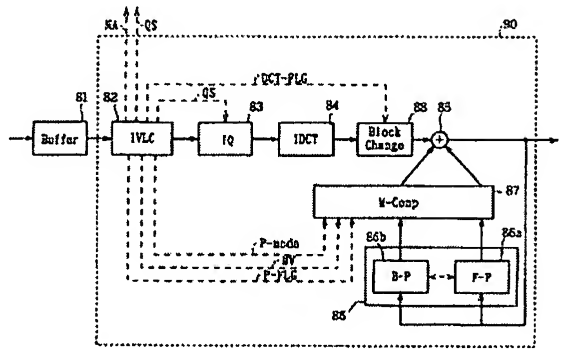
Drawing 12



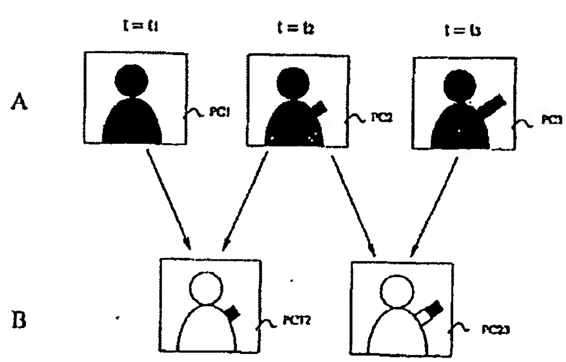
Drawing 16



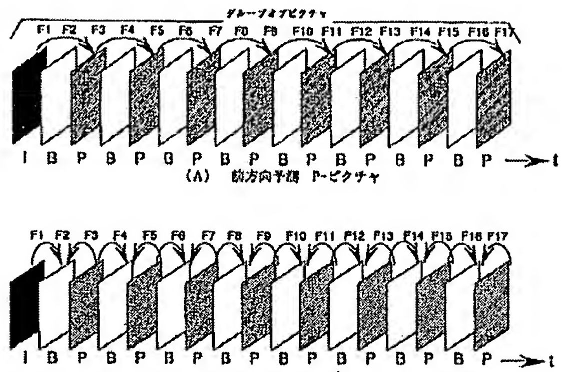
Drawing 14



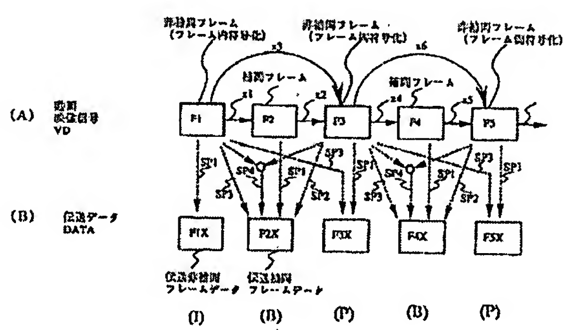
Drawing 17



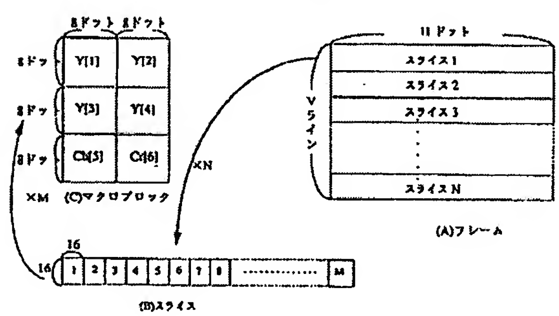
Drawing 18



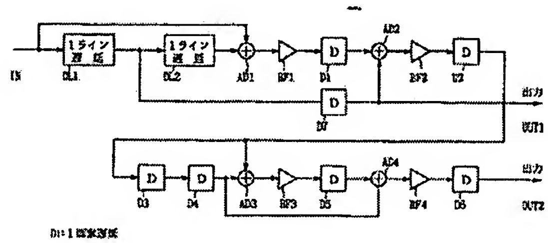
Drawing 19



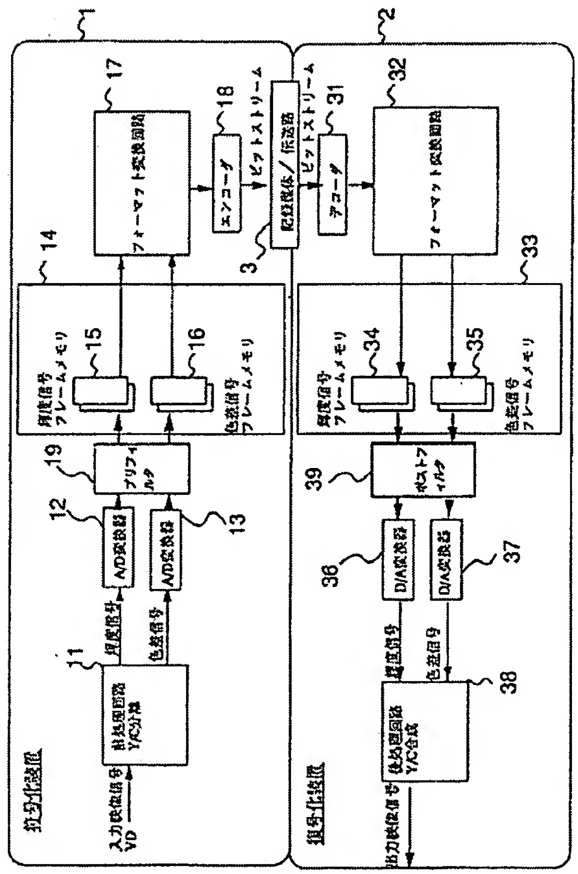
Drawing 21



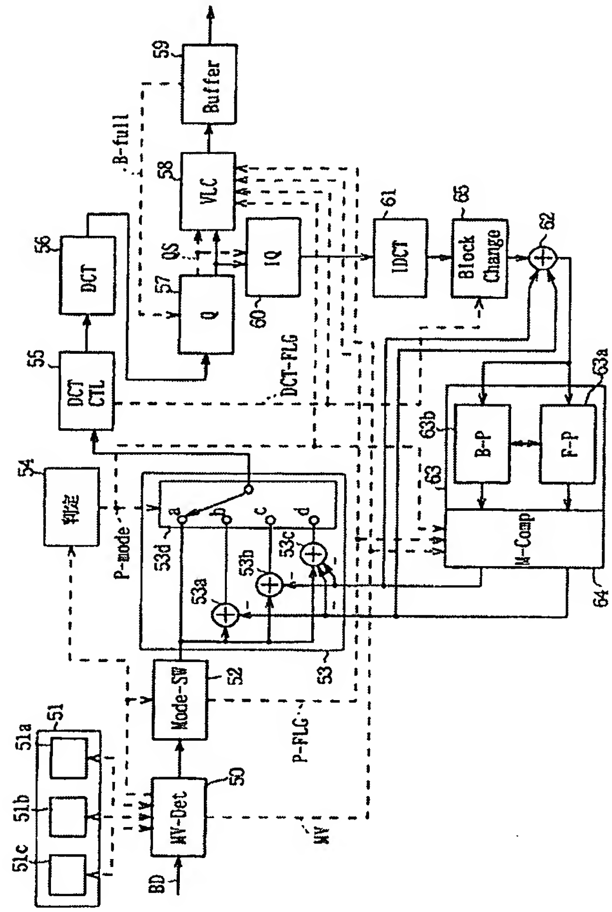
Drawing 26



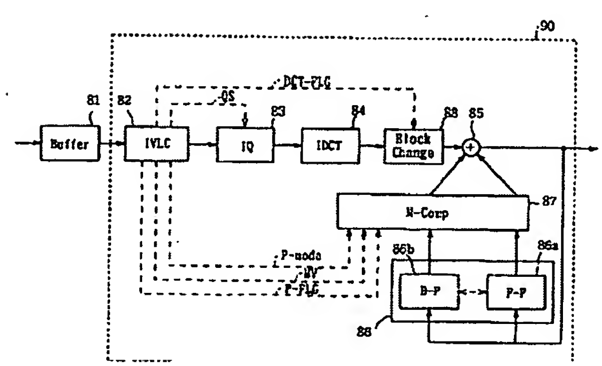
Drawing 20



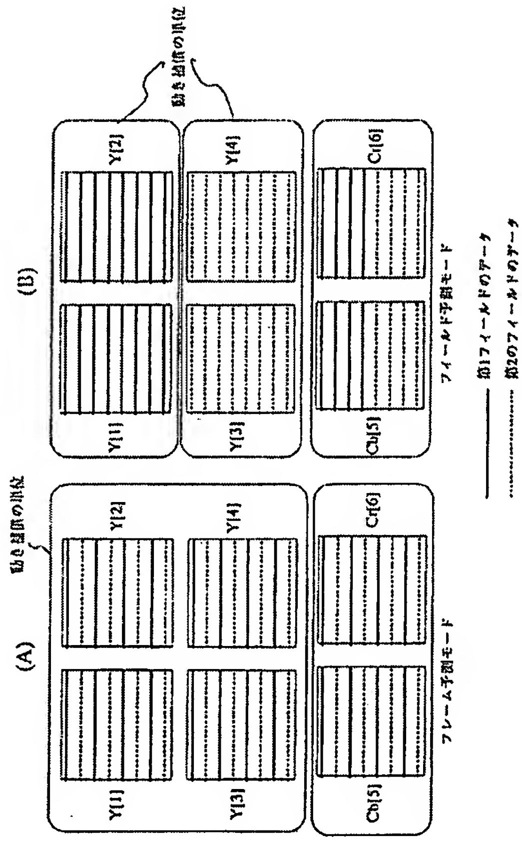
Drawing 22



Drawing 25



Drawing 23



Drawing 24